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Human Factors and safety in design How they are integrated in International Design Guidelines?

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DESSAU

From Psychology to Guidelines and Standards

Guidelines

- Road design guidelines are necessarily general
- Based on prevailing and predicted vehicle dimensions and performance, driver behaviour and current technologies.
- Human factors are to be integrated into guidelines to explain their existence and specifically define the influence of spatial environment on the user of the infrastructure.
- How guidelines are applied depends on agency policies, transportation characteristics
- New implementation for human factors will be easier if they are integrated in official guidelines

From Psychology to Guidelines and Standards

Standards

- Design standards usually based on laws of physics or empirical data
- Designers have come under pressure to reduce construction costs by using lower standards,
- Design dimensions that do not meet standards do not necessarily result in an unacceptable design – and dimensions that meet standards do not guarantee an acceptable and safe design.
- Every detail which has a relation with any human factors elements shall be correctly included in the standards and also well explained.

From Psychology to Guidelines and Standards

Standards

- Most of the non-explained incidents on highway were correctly designed following the standards, with a correct integration of human factors best practices found in different countries; most of these incidents will be solved.

The comparison Audit Table

- For each standard, the auditor has to verify more than 200 design elements related to Human Factor.

- The result comes from the comparison audit table of current international road design standards and/or guidelines and best practices of the following countries: Netherlands (NL), Portugal, Canada, India, Germany, France, Australia, Japan, Hungary, Czech rep., and China.

- For each specific Human Factors description, a list of design elements has to be verified and detailed as references in the standards.

The comparison Audit Table

- Also, integration of HF in standards is evaluated as Yes, Partial or No with some variances, principally for the Yes result as it is divided into YD as Yes Directly integrated and YI Yes Indirectly integrated. The difference is based on the fact if the standard included HF and it is introduced in relation with HF or not.

- The use of this terminology was not consistent among the various auditors indicating that the level of HF inclusion was perceived differently by most.

The comparison Audit Table

II.2 Fixation objects in the lateral roadside environment support optimal lane tracking	Design elements which are related to HF requirements	HF requirements integrated in standard?	If Yes, how? (please provide details of the design standard, a summary of the HF provisions and attach relevant sketches/formulas)	Assessment Conclusion and Recommendation
- optical framing of curves?	road side design (guard rails, etc.)	Y	Since guardrails and roadside equipment are not provided for guidance, standard propose the safety issue without really taking care of the lane tracking in curve	
o lateral orientation/guidance line on the outside of curve is	noise protection	N	Usually parallel to the roadway but no detail in GDGCR	
o there are no gaps in the lateral orientation/guidance line on the outside of curve (curve alignment markers, continuous planting…)	drainage plan: ditches, depression / embankment, cut and fill	N	GDGCR propose standards which cover all elements along the road to provide a safe road, explicitly nothing refer to optical framing of curves	
o no obstructions to the lateral sight distance on the inside of curve also the edge line marking is visible	coordination of horizontal and vertical design	Y	GDGCR provides instruction and a discussion for the designer to avoid loss of visibility, better is the coordination between horizontal and vertical alignment, better will be the perception of both edge of pavement. MUCTD presents the signalization required to support sharp curve, adding sometime delineator to help tracking the edge of the curve.	

The General Voting table

Human Factor demand	Yes (%)	P (%)	No (%)
I.1. transition zone long enough for perception, orientation and Decision Sight Distance	60%	15%	25%
I.2. perception and visibility of intersections, curves and right-of-way is provided for	40%	40%	20%
Total for 6-Seconds Rule	**50%**	**30%**	**20%**
II.1 Field of View not monotonous; length visible approaching sections avoided	0%	50%	50%
II.2 visual cues on lateral roadside give optical guidance and avoid optical illusions	10	20%	70%
II.3 eye-catching objects support lane-tracking and detection of critical points	15	25%	60%
Total for Field of View Rule	**10%**	**30%**	**60%**
III.1 each change of function is signalled by a change in the road's optical characteristics	20%	20%	60%
III.2 each change of direction is visible despite an eye-catching orientation line	0%	40%	60%
III.3 changes in any road feature that require relearning of pre-programmed habits are signalled early and clearly	30%	30%	40%
III.4 multiple critical points do not occur concurrently	50%	0%	50%
III.5 traffic control devices are legible, in accordance with driver expectation	65%	20%	15%
Total for Logic Rule	**30%**	**20%**	**40%**
Total	**30%**	**25%**	**45%**

The General Voting table

- From this point, experts from the HF subgroup have a good idea where to search to find best practices.

- The major problem as it is presented in the preceding section is the correct understanding of the Human Factor Element and its real integration in the standards.

- More than 70% of HF are not integrated in Standards and less than 30% are integrated.

Best Practices

Four major sources for standards

- AASHTO
- French Standards
- United Kingdom (British Standards)
- German Standards

Best Practices

Limits

- Results are sometime limited by the used of standards that the designer could understand and read.
- One of the major difficulties is to try to use all the potential of existing standards and guidelines.
- Results were limited to the analysis and audit on Standards usually utilised by the member of the subgroup.
- Even if some standards were not audited the group decided to analyse Standards where good practices and example were found.

Best Practices

Examples - Transition zone

Good practice of deceleration at pedestrian crossing – South Sweden (Photo ing. Jiri Landa)

Best Practices

Examples - Transition zone

Good practice of town entrance – Nybro, South Sweden! (Photo ing. Jiri Landa)

Best Practices

Examples - Perception and Visibility

Aerial view of intersection in Solihull, UK

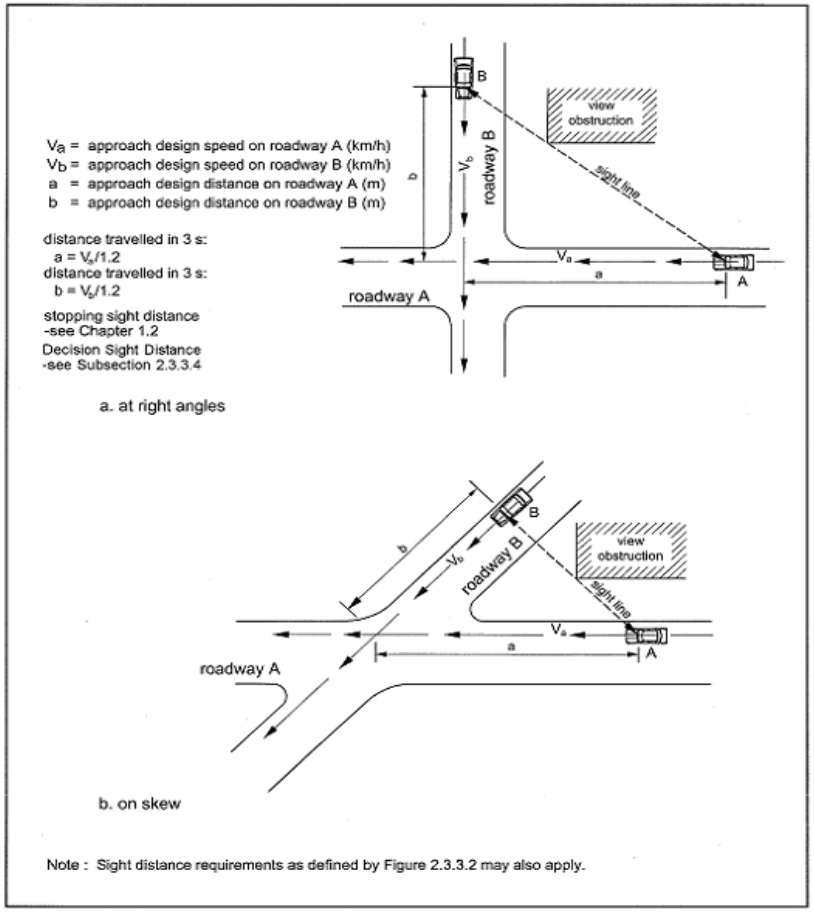
Best Practices

Examples - Perception and Visibility

Aerial view of shark tooth before a slower posted speed, UK

Examples - Perception and Visibility

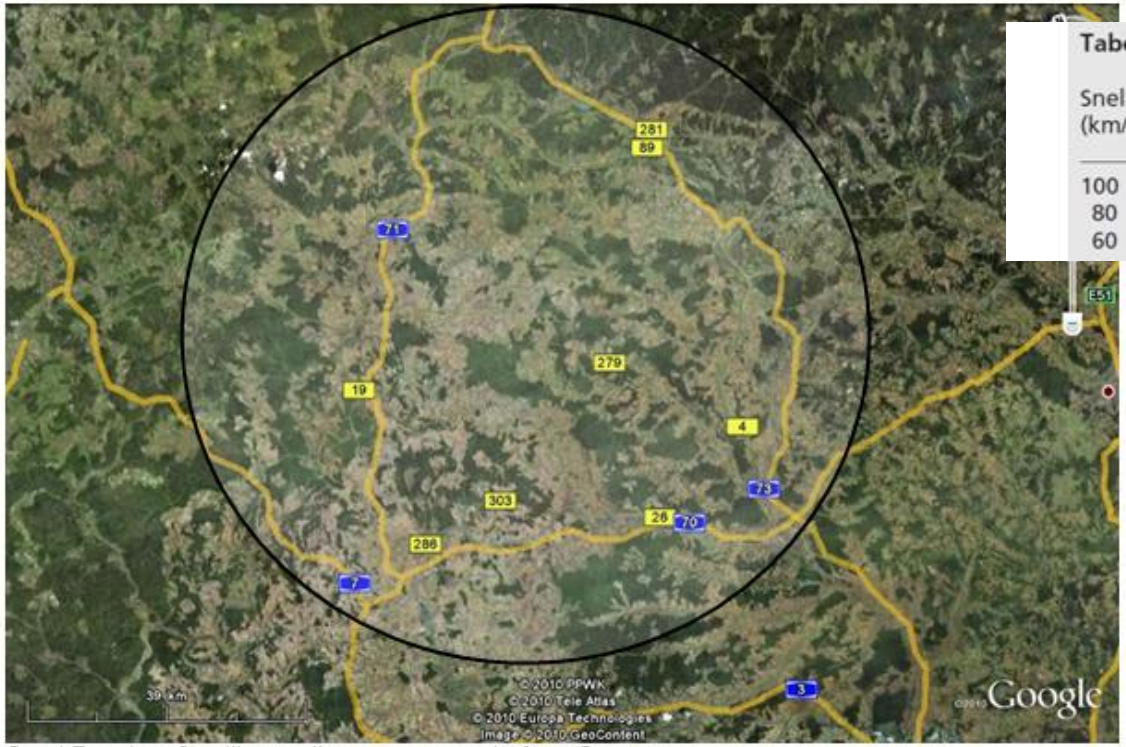
Figure 2.3.3.1 Approach Sight Triangles



Note : Sight distance requirements as defined by Figure 2.3.3.2 may also apply.

Best Practices

Examples - Optical density of the field of view - speed management



Good Practice: Curvilinear alignment- example from Germany

Tabel 7-4. Maximale lengte horizontale rechtstand

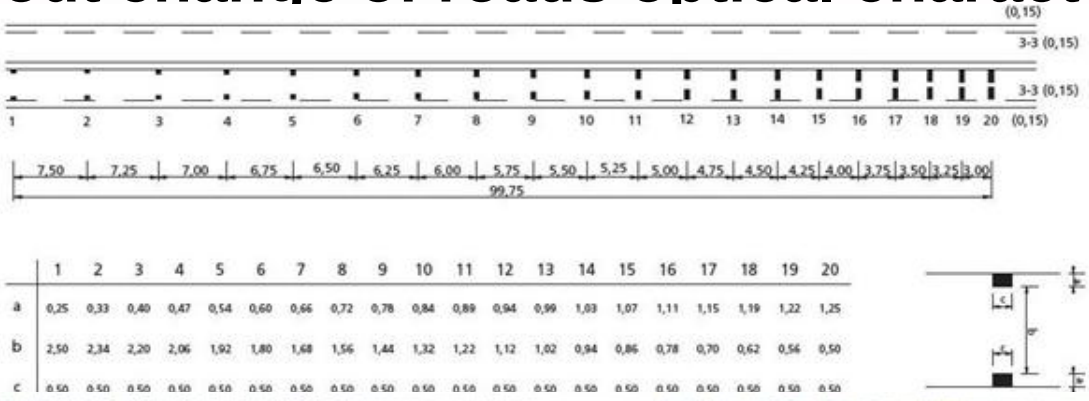
Snelheid (km/h)	Maximale lengte horizontale rechtstand (m)
100	< 2000
80	< 1600
60	< 1200

Best Practices

Examples - Depth of field of view - speed management

Best Practices

Examples - Optic Town entrance (change of function without change of roads optical characteristic)



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
a	0,25	0,33	0,40	0,47	0,54	0,60	0,66	0,72	0,78	0,84	0,89	0,94	0,99	1,03	1,07	1,11	1,15	1,19	1,22	1,25
b	2,50	2,34	2,20	2,06	1,92	1,80	1,68	1,56	1,44	1,32	1,22	1,12	1,02	0,94	0,86	0,78	0,70	0,62	0,56	0,50
c	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50

Best Practices

Examples - Deficiencies in traffic control devices

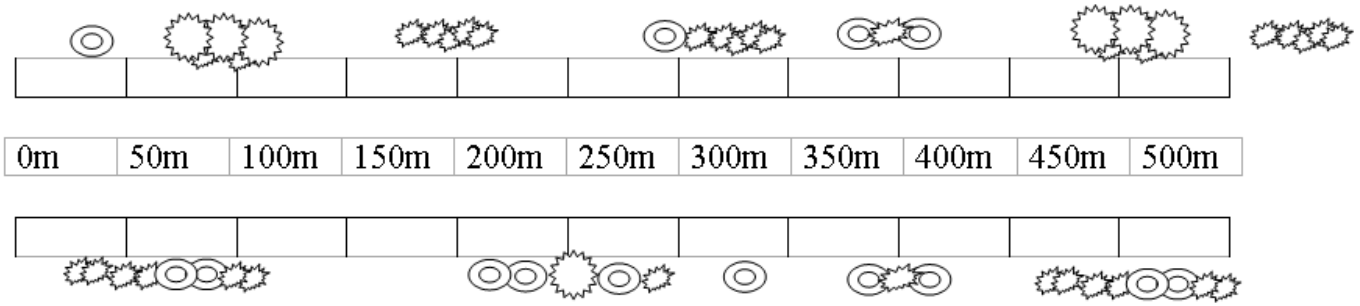
Best Practices

Examples - Deficiencies in traffic control devices

Additional traffic lights at the pedestrian crossing! (Photo pplk. ing. Vladimir Mensik)

Proposals for Missing Links

- BEST PRACTICES FOR PLANTING



low bushes (up to about 1.50 m)
medium-height bushes (up to about 3-4 m)
tall trees (4 m and over)

FIG. 155: PLANTINGS THAT VARY IN INTERVALS AND IN HEIGHT

(Source: MSWV, HVO, Brandenburg)

Proposals for Missing Links

- STRUCTURES OVER THE ROAD

Conclusion

- Agencies must change their own standards to integrate human factors and specifically the influence of the spatial perception on road safety.
- Best practices from foreign countries shall be evaluated and adapted to each standard.
- Spatial perception of the environment influences the driver and situation shall be analysed always with the objective to prepare a safer project.
- Changes in standards to integrate human factors don’t mean necessarily an increase of the construction cost
- Agencies should inform and train their designer to implement design elements where the spatial perception are included.

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Thank you for your attention